



ANNUAL REVIEW OF NUTRITION

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FOREWORD

When Dr. Darby asked me to participate in the launching of the *Annual Review of Nutrition* by contributing a few paragraphs for use in the introductory volume, I felt singularly honored. I experienced a rosy sort of feeling that was soon replaced by fear and trembling: I know all too little about the modern science of nutrition. Furthermore, as the ravages of age manifest themselves, some of us who were once much younger become cynical, pessimistic, and unpleasantly negative about the happenings in this increasingly complicated world. Had I been turned loose on organizing and structuring this new *Annual Review*, much of the space would probably have been devoted to attacks on food faddism and tirades against the pseudo-scientific and nutritional nonsense to which the media constantly expose us. And then there are the many who urge that our great uncle in Washington guarantee for us an environment that is totally risk-free, including the food we eat, the water we drink, and the air we breathe. I doubt that even Heaven provides a risk-free haven.

Fortunately, the Editorial Committee and the authors, whatever they may choose to do about the dispensers of such nonsense, will harvest much from the ever-expanding literature of science that will be of inestimable value to all who are seriously interested in the science of nutrition.

Recently, in thumbing through the 49 volumes of the *Annual Review of Biochemistry* that have thus far appeared, I was astonished by two discoveries that are relevant and significant. Each of the first 29 volumes contained a chapter on human nutrition. Volume 31 contained a review on germ-free animal research, and Volume 40 brought us up-to-date on nutritional methodology in metabolism research on rats. In a few of the first 15 volumes some bits of wisdom are to be found on the nutritional requirements of bacteria, protozoa, insects, chicks, monkeys, pigs, and cattle. But beyond this, and with only a single exception, the word "nutrition" does not even appear in the subject index of any volume from 32 in 1963 to 49 in 1980. *Horribile dictu!* It is, indeed, high time for the science of nutrition to gain the special recognition that it deserves through the *Annual Review of Nutrition*. I wish this new publication well. The first volume deserves a special salute by the biochemical community, for it appears during the Golden Jubilee year of the *Annual Review of Biochemistry* and the 75th anniversary of the birth of the *Biochemical Journal*.

Why was nutrition as a subject appropriate for review dropped from the *Annual Review of Biochemistry*? In part, the omission must be attributed to the "spin-off" to which the Editorial Committees of years gone by were

dedicated as a means of countering the onset of obesity which has threatened the *Annual Review of Biochemistry* from its infancy. Thus, the advent of the *Annual Review of Physiology* in 1946 permitted the biochemists to give the kidneys, liver, nerve, and brain to the physiologists. In 1950 almost the whole of plant biochemistry was transferred to the fledgling *Annual Review of Plant Physiology*.

As for nutrition, it seems to have merely faded away. But not quite. I think that two things contributed to its disappearance from the *Annual Review of Biochemistry*. More and more of nutritional research was on vitamins, which has continued to be a lively field of investigation and an important topic in the *Annual Review of Biochemistry*. And secondly, much of the remainder was reviewed in the ever-recurring chapters on metabolism (of carbohydrates, lipids, amino acids, and inorganic elements).

But now the early 1960s are in the distant past. The judgments of today's science are not those of yesterday's. Convinced that nutrition, as an active and thriving scientific discipline, has never ceased to be of worldwide interest and importance, I welcome the *Annual Review of Nutrition*. Eventually it may be threatened with the obesity that has plagued its parent but, of all people, those of you who are contributing to the science of nutrition will surely know how to maintain the pristine beauty and health of this new *Annual Review*.

J. MURRAY LUCK
Founder, Annual Reviews Inc.

PREFACE

The decision by the Board of Directors of Annual Reviews Inc. to initiate this new series, *Annual Review of Nutrition*, is one that nutrition scientists widely applaud. The responsibility placed upon the Editorial Committee offers an opportunity, indeed a challenge, to define better the limits of the science of nutrition through judicious selection of the topics reviewed and assuring that the reviews are critically prepared to reflect scientific advances and that they consolidate and place in appropriate perspective the significance of current research.

Contrary to much popular misconception, nutrition as a subject has been of serious interest and concern to centuries of natural philosophers, physicians, and scientists. Interest in food and health and the state of nutrition (nutriture) is abundantly evident in the aphorisms of Hippocrates, in the writings of Celsus, as well as in the legacies of ancient cultures such as early records from China and ancient Egypt. The curative properties of fruits and fresh vegetables in combating scurvy were recognized by many European physicians who preceded James Lind. It was Lind, however, who proved through neatly designed and executed clinical experiments, the antisorbatic property of citrus fruits that he described in his classical "Treatise on the Scurvy," published in Edinburgh in 1753. This study remains a classic not only in the field of nutrition, but also in clinical investigation as the first precisely designed therapeutic experiment in medicine. Subsequent physiologic studies of animal heat and respiration (oxidation) by Lavoisier and the discovery of oxygen by Joseph Priestley and Carl Scheele 200 years ago are widely regarded as the events marking the beginnings of the modern science of nutrition.

However, the science of nutrition did not suddenly emerge as a separate discipline; rather it was nurtured within the disciplines of physiology, pathology, medicine, organic chemistry, and agricultural chemistry, only gradually to emerge as a scientific discipline. Similarly, some 100 years ago, "physiological chemistry" emerged from physiology as a recognized discipline in the United States with the establishment of the Yale laboratory under Russell H. Chittenden. In so doing, it embraced as a major interest much of nutrition. Evidence of this is seen in the table of contents of the *Journal of Biological Chemistry*, the *Biochemical Journal*, and other scientific journals from then through the early 1940s. Volume 1 of the *Annual Review of Biochemistry* 50 years ago carried a chapter on nutrition. Subsequent volumes likewise reviewed this field in a special chapter, and usually contained as well other papers basic to nutrition, on subjects such as water-

soluble vitamins, fat-soluble vitamins, amino acids, protein, lipid, and mineral metabolism, and the like. The last separate treatment of "nutrition" was in Volume 31, 1964, although a chapter on "Nutritional Methodology in Metabolic Research with Rats" appeared in Volume 40, 1971. This changed content of *Annual Review of Biochemistry* reflected the intensity of development of biological and medical research, especially as related to biological chemistry and molecular and cellular biochemistry. It did not indicate a decrease in research activity pertaining to nutrition. Hence, there has existed a void in the coverage and synthesis of the scientific advances of nutrition—a void that this new series is designed to fill.

It is significant that this year, 1981, marks the 75th anniversary of the passage of the Pure Food and Drug Act and the Meat Inspection Act, as well as the 40th anniversary of the founding of The Nutrition Foundation, which immediately thereafter established the monthly review journal *Nutrition Reviews*.

The enormous growth of the scientific literature of nutrition and the penetration of research in, and practice of, the science into all disciplines of medicine, the biological sciences, and even into economics, sociology, anthropology, paleontology, and various applied fields (public health, food technology, household science, and government services) have created a need for this annual series of critical, authoritative surveys of the original literature describing the current developments in the science of nutrition. The selection of papers for inclusion will be guided by the principle that critical analysis and resumes of selected aspects of topics discussing the most significant contributions will serve the reader better than superficial mention and hasty identification of most of the papers appearing during the period covered by the review. The advances in some subject areas will justify reviewing annually; advances in other areas will warrant review only at intervals. The distribution of topics between "basic," "clinical," and "applied" will vary from year to year, but always in adherence to the principle of disciplined scholarship and science. In fact, as underscored by Sir Harold Himsworth, research in nutrition represents a continuum from the mission-oriented clinical extreme to unspecialized basic biology. Hence, classification as basic, clinical, or applied represents no true distinction in terms of rigid scholarship or disciplined approach—in fact, often methods of study are so combined that separate classification is patently impossible.

The societal concern for foods and nutrition cannot be ignored in this series, but these will be examined with the same standard of scholarly deliberation as characterizes critiques of "hard science." The opening essay of this first volume of *Annual Review of Nutrition*, "The Moral Dimension of the World's Food Supply," is by a humanist, Professor Samuel E. Stumpf, a philosopher long concerned with ethical considerations pertain-

ing to medicine, food use, and regulatory decisions. It is anticipated that this essay will set the tone for future introductory essays.

The Editors are grateful for the opportunity of initiating this series which we trust will serve those concerned with the science of nutrition and its application as valuably and effectively as does the prestigious 50-year-old series, the *Annual Review of Biochemistry*.

We are especially pleased that J. Murray Luck, who initiated *Annual Review of Biochemistry* and served as its first Editor, and who is a longtime friend of the Editors, has written the Foreword to this new series. The Editorial Committee congratulates J. Murray Luck upon the 50th anniversary of the remarkable institution that he launched, Annual Reviews Inc., and the great service that he has thereby rendered to the broad scientific community.

The Committee wishes also especially to thank the staff of Annual Reviews Inc. for their efficient efforts to bring this volume to fruition within shortly over a year since the decision was finalized to initiate the series. This would have been impossible without the remarkable cooperation of the authors of the 18 chapters. To these authors both Editors and staff extend their deeply felt appreciation.

WILLIAM J. DARBY
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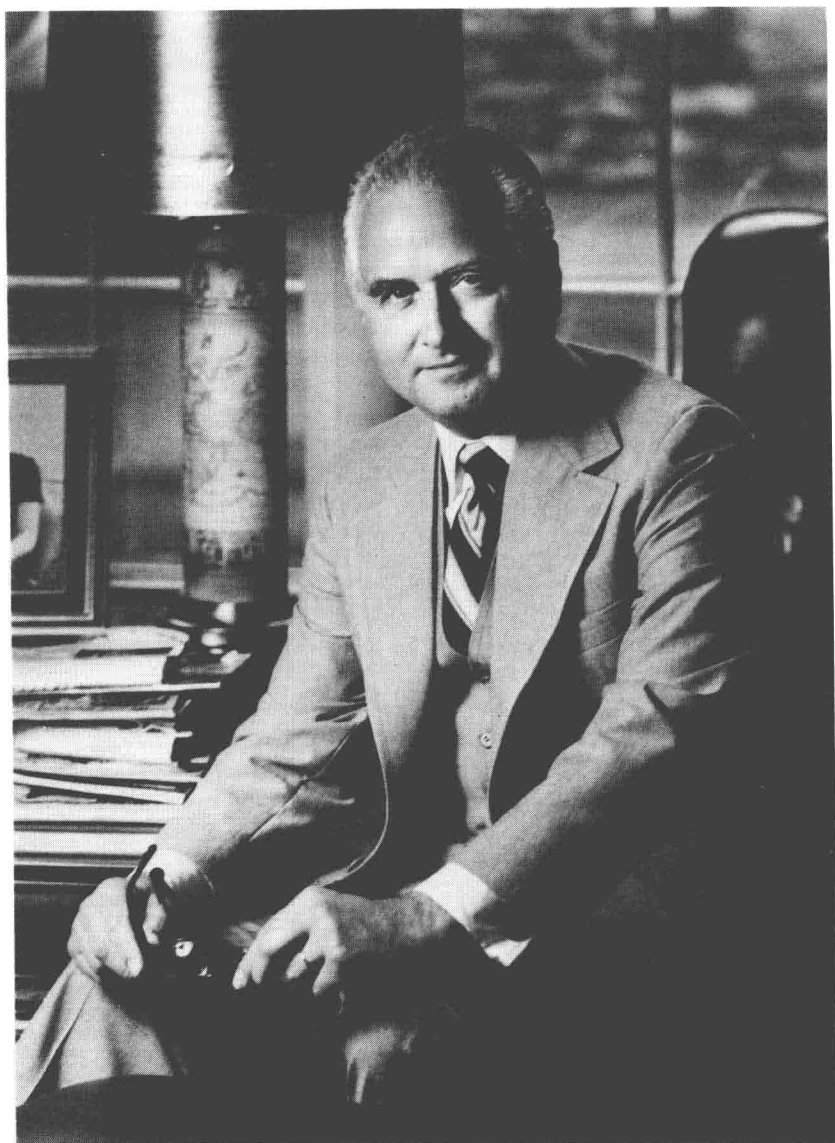
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Samuel S. Stumpf



CONTENTS

THE MORAL DIMENSION OF THE WORLD'S FOOD SUPPLY, <i>Samuel E. Stumpf</i>	1
IRON ABSORPTION AND TRANSPORT IN MICROORGANISMS, <i>J. B. Neilands</i>	27
CULTURAL NUTRITION: ANTHROPOLOGICAL AND GEO- GRAPHICAL THEMES, <i>Louis Evan Grivetti</i>	47
SODIUM AND POTASSIUM, <i>Melvin J. Fregly</i>	69
DIETARY CHOLINE: BIOCHEMISTRY, PHYSIOLOGY, AND PHARMACOLOGY, <i>Steven H. Zeisel</i>	95
BIOAVAILABILITY OF DIETARY IRON IN MAN, <i>Leif Hallberg</i>	123
IRON, COPPER, ZINC, AND MANGANESE IN MILK, <i>Bo Lönnerdal, Carl L. Keen, and Lucille S. Hurley</i>	149
METABOLIC FATE OF FOOD COLORANTS, <i>Thomas M. Parkinson and Joseph P. Brown</i>	175
THE ROLE OF NUTRITION IN TOXICOLOGY, <i>Dennis V. Parke and Costas Ioannides</i>	207
REGULATION OF ENERGY BALANCE, <i>N. J. Rothwell and M. J. Stock</i>	235
THE GERM-FREE ANIMAL IN NUTRITIONAL STUDIES, <i>Bernard S. Wostmann</i>	257
FORMATION AND MODE OF ACTION OF FLAVOPROTEINS, <i>A. H. Merrill, Jr., J. D. Lambeth, D. E. Edmondson, and D. B. McCormick</i>	281
SOME NUTRITIONAL CONSIDERATIONS IN THE CONDITIONING OF ATHLETES, <i>E. R. Buskirk</i>	319
METABOLISM AND NUTRITIONAL SIGNIFICANCE OF CARO- TENOIDS, <i>Kenneth L. Simpson and C. O. Chichester</i>	351
EPIDEMIOLOGICAL STUDIES OF HEALTH EFFECTS OF WATER FROM DIFFERENT SOURCES, <i>R. Masironi and A. G. Shaper</i>	375
TAURINE IN METABOLISM, <i>K. C. Hayes and J. A. Sturman</i>	401
FLUORIDE AND HEALTH: DENTAL CARIES, OSTEOPOROSIS, AND CARDIOVASCULAR DISEASE, <i>R. G. Schamschula and D. E. Barnes</i>	427
NUTRITIONAL SIGNIFICANCE OF FRUCTOSE AND SUGAR ALCOHOLS, <i>Yeu-Ming Wang and Jan van Eys</i>	437
INDEXES	
AUTHOR INDEX	477
SUBJECT INDEX	502

THE MORAL DIMENSION OF THE WORLD'S FOOD SUPPLY

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*Samuel E. Stumpf*¹

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THE MAKING OF A MORAL PROBLEM

The moral issues growing out of the world food problem are every bit as urgent as the growing scarcity of food itself. It is, of course, because of this scarcity that most of the moral issues arise. If it is a fact that the population of the world is growing at a far more rapid rate than is the quantity of food, then it is simply a question of time before there are more people than the world can feed, and it is predicted by some experts that the moment when this imbalance will occur is virtually upon us. By now we are familiar with the estimate that we are running out of arable land, pure water, and sources of energy at a time when we are adding each year about 80 million human beings to the world's population.

Whether we face unique moral problems depends to some extent upon the accuracy of information and predictions. Ours is not the first era in history when catastrophe was expected. When Malthus formulated his famous theory in 1798, he was convinced that population would always "press against food," that because of the geometric increase in population with only an arithmetic increase in the food supply, it would turn out that "in two centuries and a quarter, the population would be to the means of subsistence as 512 is to 10, in three centuries as 4096 to 13 and in two thousand years the difference would be incalculable."

Almost 200 years have passed since Malthus presented his gloomy forecast, raising the question of whether or not he had sufficiently taken into account the capacity of human ingenuity to derive from nature a vastly increased basis for subsistence. Even if the ratio of people to food were as permanent in nature as are Newton's laws of physics, would not the possible tragic consequences to mankind be averted by breaking through the slow

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rate of growth in the food supply by means of technological advance? Moreover, was it inevitable that the only check on the growth of population would be the twin forces of "vice and misery," or wars, famine, and disease?

Although the steam engine had been invented in 1776, over 20 years before he published his *Essay on Population*, Malthus did not see in this device the possibility of substituting machine power for human energy, which would thereby radically alter the impact of his theory, which held, among other things, that there is a principle of diminishing returns at work reducing the output of the newest additions to the work force. This view was still held by John Stuart Mill in the nineteenth century when he wrote that "it is vain to say, that all mouths which the increase of mankind calls into existence, bring with them hands. The new mouths require as much food as the old ones, and the hands do not produce as much." But mechanization has changed all that. And there might be additional ways to control population, a point Malthus emphasized in a revised edition of his *Essay*. Although he did not favor mechanical means of birth control, and might not have been pleased to know that later on contraceptives were referred to by some as "Malthusian devices," Malthus did focus upon the need for some deliberate method of population control. The most acceptable way to control population, he argued, was through "moral restraint," which would delay marriage until prospective parents had some assurance they could support their children.

Whether our present worries about the food supply confirm Malthus's worst predictions or whether we stand on the threshold of major discoveries that would alter these gloomy predictions depends upon information not fully available at present. There are reasons for considerable optimism based upon the spectacular achievements of the Green Revolution, the novel modes of planting, fertilization, irrigation, the many forms of mechanization, the genetic alteration of plants and animals, and the rapid advances in biochemistry. Moreover, the use of more sophisticated and effective techniques of birth control can provide a check upon the expanding population. But these advances are not without some complexities. Already we are told that there is an upper limit to what we can expect from the Green Revolution. Not only can we expect a limit to the yield per acre, but the cost of achieving this yield is rising rapidly beyond the ability of some countries to afford it. Objectively, it costs more in energy to produce some foods than there is energy, measured in calories, contained in the food. But unlike Malthus, who could not even envision technological developments, we can aggressively pursue likely alternative solutions, as for example the possibility of harnessing solar energy. We can therefore afford to suspend final judgment of our present predicament on the reasonable assumption that the causes of our present crisis are temporary or transitory. Even the

present uncertainties about the ultimate safety of the contraceptive pill may not be a serious setback, notwithstanding the loss of time in research on new birth control devices caused by the earlier reliance upon the pill as the sure method of controlling the population.

In one sense we do stand where Malthus stood in spite of our immense technology, for, as I have just pointed out, the developments in food technology might not continue at their recent rapid rate, nor might sufficient resources exist in the long run to provide the prerequisites for a universal Green Revolution among the countries of the world. To the extent that the supply of food has increased, the problem has been aggravated, as this increased supply has caused the population to expand and its capacity to reproduce to increase. Even the provision of health services among previously deprived peoples has had the effect of nullifying some of the gains in the food supply by further increasing the size of the surviving population.

Frequently, a promising breakthrough is counterbalanced by some adverse prediction. Some experts feel, for example, that if Bangladesh and other Asian countries were to raise the yield of their rice crops even by "a cupped handful per square meter," hunger in those nations could virtually be eliminated. By contrast, scientists who study the trends in the world's climate point out that recent changes in temperatures are not minor or transitory but indicate a serious long-term cooling. Some of the findings of our climatologists may hardly seem threatening or even relevant to our immediate problems when they speak in terms of the possible repetition of a previous "100,000-year glacial episode" or even "a little ice age" that began in 1300 and was interrupted in the late nineteenth century. But when they point out that during the last 35 years the temperature in Iceland has fallen back to its pre-1900 level and its ports have been iced-in for the first time in this century, leading to a drop of 25% in per-acre hay yields, and when they inform us that the average growing season in the English lowlands is almost 2 weeks shorter than it was in 1940, and when Kenneth Hare, former president of Britain's Royal Meteorological Society, warns that "I don't believe the world's present population is sustainable if there are more than three years like 1972 in a row," then the trends in the world's climate take on a level of urgency hardly imagined even a few years ago. Moreover, given the vastly increased population today compared with the small numbers of people on the earth during earlier changes in the climate, any major change now would be calamitous. A prolonged monsoon failure in Asia would affect the most densely populated areas of the world, whereas a prolonged drought could also affect the world's huge granaries in the Soviet Union and North America.

Whatever the predictions concerning the world's food supply, whether optimistic or pessimistic, virtually every moral issue that surrounds this